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Abstract

A Study on the Diffusion Length of Thermal Neutrons in Terphenyl (Santowax - R) at High Temperatures up to 400°C

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It is needless to say that the temperature dependence of the diffusion length is quite important in relation with the neutron transport cross section as a basic reactor parameter according to the temperature rise of modern reactors.

The diffusion length of thermal neutrons in various moderators containing hydrogen has been studied for a long time, especially in the theoretical field. However, only few experiments continuously in the wide temperature range have been reported, although some experiments and calculations at the temperatures comparatively low or at the spot temperature have been published.

It seems that this is due to the engineering difficulties, such as using water at high temperature.

However, it is being thought that the deviation from the 1/v law due to the effect of molecular binding would be fairly remarkable at the temperature above 200°C.

In this work the temperature dependence of diffusion length of thermal neutrons in terphenyl ($C_{18}H_{14}$) has been measured in the wide range from 200°C to 400°C continuously, and the transport cross section was studied in connection with the results. From the results in comparison with the calculated value, using $\sigma_S(E)$ from Brugger's experimental data on the scattering law about Santwax-R, it is clear that there is still a problem in assuming that the diffusion length varies as $\frac{1}{\rho}\sqrt{T}$ at high temperature over 300°C, and it

might be considered that the temperature dependence of the diffusion length in hot water would be deduced from an analogy of this work.

In this report many engineering problems as mentioned below, encountered in making the measurements under this condition, will be stated, too.

(1) Uniformity of temperature distribution geometrically during the experiments.

(2) The figure of the flux including the effect of the epithermal neutrons.

(3) Measurement of the neutron flux, that is the difficulty of using cadmium and indium foils due to the high temperature, i.e., development of gadolinium and dysprosium foils.